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9th Part of AAEE/866/1

MINISTRY OF SUPPLY

AEROPLANE AND ARMAMENT EXPERIMENTAL ESTABLISHMENT

BOSCOMBE DOWN

SHACKLETON MK.2 WB.833
(4 GRIFFON 57)

RADIO ACCEPTANCE TRIALS

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9th Part of Report No. A.A.E.E./866/1

AEROPLANE AND ARMAMENT EXPERIMENTAL ESTABLISHMENT 1? FEB.1953
BOSCOMBE DOWN

Shackleton Mk.2 WB.833
(4 Griffon 57)

Radio Acceptance Trials

A.& A.E.E. Ref: AAEE/411/31/Radio
M. O. S. Ref: 39th Joint Meeting, Ministry of Supply.
Period of Trials: 31st July, 1952 to 7th November, 1952.

Progress of issue of Report

Report No.	Title	
4th Part AAEE/866/1	VW.126	Handling Trials at a Forward C.G. Position.
5th - do -	WG.530	Brief Engine & Oil Cooling Trials made under near ICAN Conditions.
6th - do -	WB.833	Handling Trials on the First Production Aircraft.
7th - do -	WB.833	Cockpit Appraisal.
8th - do -	WB.833 WG.530	Comments on Crew Comfort during Flights of Long Duration.

Summary

Acceptance trials on a Shackleton Mk.2 were required in accordance with the 39th Joint Meeting, Ministry of Supply, covering the following equipments:-

A.S.V. Mk.13 (with retractable radome)
A.R.I. 5487 (Sono-buoy)

Also included in this report are comments made by a Coastal Command Navigator who participated in the trials.

The Radio Compass installation will be cleared by R.A.E. and is therefore not included in this report.

The following equipments are cleared by analogy with those in the Shackleton Mk.1 and are covered in that report.

GEE Mk.2	T.1154/1155
Loran Mk.1	TR.1920 (Two)
I.F.F. Mk.3 G.R.	A.1134A (Intercomm.)
Rebecca Mk.4	A.R.I.5388 (i/c Switching)
A.Y.F.	

It is considered as a result of these trials, that the Shackleton Mk.2 installations are acceptable for service use, subject to rectification wherever possible of the criticisms listed in paras. 4.1.1 to 4.1.12, and that the A.R.I. 5487 Aerial polar diagram covers tactical requirements.

This report is issued with the authority of

Air Commodore,
Commanding A.& A.E.E.

List of Contents

List of Illustrations

/1. Introduction.....

1. Introduction

1.1 Radio Acceptance Trials have been carried out on a Shackleton Mk.2 aircraft covering the following equipments:-

A.S.V. Mk.13 (With retractable radome)
A.R.I. 5487 (Sono Buoy, three stations)

1.2 No trials were carried out on the Radio Compass installation as it was understood that R.A.E. would give the necessary clearance; or on the following installations which were cleared by analogy with those in the Shackleton Mk.1 and were covered in the 17th part of A. & A.E.E. Report No. 866.

GEE Mk.2	T. 1154/1155
Loran Mk.1	T.R. 1920 (Twin)
I.F.F. Mk.3 G.R.	A. 1134A (Inter-comm.)
Rebecca Mk.4	A.R.I. 5388 (i/c Switching)
A.Y.F.	

1.3 Included in this report are comments made by a Coastal Command Navigator who participated in the trials.

2. Object of Trials

2.1 To clear the Shackleton Mk.2 radio installations as detailed in para. 1.1 which differed from those in the Mk.1.

2.2 To make recommendations for modification, either to the installation or service equipment as considered necessary.

3. Reports Issued

3.1 Already issued:- Shackleton Mk.1: 17th part of A. & A.E.E. Report No. 866.

3.2 Included in this report:- A.S.V. Mk.13 and A.R.I. 5487 only.

3.3 Reports to follow:- Nil.

4. A.R.I. 5729 (A.S.V. 13)

4.1 Installation Details

4.1.1 Scanning Unit Type 85 with its associated equipment was mounted in a retractable radome amidships on the underside of the fuselage, with switching facilities for three different extended positions, i.e. 1st Search", "2nd Search" and "Attack" (Figs. 4 to 6).

4.1.1.1 It was found that the safety precautions for personnel working in the scanner compartment when extended on the ground were inadequate.

4.1.1.2 If the override switch was operated the radome traversed towards the position selected by the main selector switch only as long as the override switch was held, and hydraulic power was available; thus if the scanner was lowered to "2nd Search" position it would only remain at this point if no hydraulic power was available, or the override switch was held. Should hydraulic power be applied when the override switch was unattended, then the radome would automatically retract. This was dangerous to anyone working within the scanner compartment.

4.1.1.3 In addition to this danger, it was possible to select the "attack" position by means of the override switch, on the ground, and, unless the aircraft was jacked fore and aft there was insufficient ground clearance to allow the radome to extend fully. As there was no need

/in....

in normal servicing to lower the radome below the "second search" position, which was allowable when the tail only was jacked, it is suggested that the present override switch be deleted, and a two position switch be fitted under the scanner hatch covers in such a position as to prevent accidental operation, preferably with some form of guard flap.

4.1.1.4 The operation of this switch to be as follows:-

(a) When in "test" position, the radome to be lowered to "2nd search" position independently of the main selector switch position and independent also of all interlocks on the undercarriage.

(b) When in "normal" position the radome to be returned to the retracted position and control of the hydraulic system to be returned to the main selector switch and undercarriage interlocks.

This system would then provide adequate safety when in the test position, assuming that the hydraulic action is dead, should the electrical supply fail.

It is understood that action is being taken to overcome this bad feature. See Form 555 dated 9th October, 1952.

4.1.1.5 It was also found desirable to have a 24 volt supply available near the scanner hatch for use when servicing the scanner. A standard inspection socket may possibly be incorporated on the panel situated to the rear of the port observation window; this socket would also serve as an Aldis lamp supply which again was not available in the Mk. II aircraft.

4.1.1.6 It may be mentioned also that during flight trials in which Coastal Command participated, no use was found operationally for the "1st search" position of the scanner, and it was considered that this position was unnecessary, (This position was useful only for setting up the heading marker on the ground).

4.1.1.7 In case of emergency a secondary system of raising the retractable radome by the use of emergency air was provided and it was not thought necessary for a third system to be incorporated.

4.1.1.8 The cables to the scanner loom have P.V.C. covering to prevent chafing. This sleeving should pass under the metal cable clamps to prevent wear at these points. (Fig.3).

4.1.1.9 A strap should be attached under the central floor support channel to take the weight of the directive feed and waveguide when the T/R Unit was removed.

4.1.1.10 In the event of a scanner change it was thought advisable to provide a scanner frame to ease positioning of the scanner in the radome.

4.1.1.11 The heavy duty cable from the bulkhead to the scanner junction box (Fig.3) should be re-routed to the opposite end of the clamp on the bracket tube above the scanner to increase the radius of the bend to the socket.

4.1.1.12 The bulkhead plugs for the cable loom to the scanner well were mounted under the floor to port and forward of the radome, and could only be reached by lowering the radome (Fig.7), this bad feature being one reason why maintenance personnel may be inside the radome when it is extended; para. 4.1.1.2 refers.

4.1.2 The Transmitter-Receiver Type TR. 3523E W/V was positioned on top and to the rear of the retractable radome platform (Fig.8), in a

/satisfactory....

satisfactory position for maintenance. The signal lead need a clip to secure the plug in its socket to prevent it falling off in flight.

4.1.3 The Modulator Unit Type 196 W/W was mounted just forward of the port radome hydraulic ram (Fig.9), and was satisfactory for maintenance.

4.1.4 The Servo Amplifier Type A. 3621 was positioned just aft and to port of the radome hydraulic ram (Fig.9). The cables to this amplifier were pulling the unit to one side; more play in the cable form should be provided to prevent this. The equiflex mountings are either of insufficient weight capacity or have fatigued.

4.1.5 The Indicator Type 211 was mounted on its tray in the centre of the A.S.V. Operator's table (Fig.10), in a good operating position. The screen edge lighting on the Indicator tested had recently been modified by the Contractor, but as can be seen in Fig. 17, was still unsatisfactory. Providing the indicator was thoroughly dry internally, no misting of the tube screen was experienced.

4.1.6 Amplifier Type A. 3644 was fitted on the port side of the A.S.V. Operator's table (Fig.10), and was satisfactorily positioned for servicing.

4.1.7 The Oscillator Unit Type 231 was mounted under the A.S.V. Operator's table on the port side (Fig.10), and was satisfactory for operation.

4.1.8 The Power Unit Type 567 W/W was mounted immediately behind the port radome hydraulic ram (Fig.9). The equiflex mountings are again either of insufficient weight capacity or have fatigued.

4.1.9 The A.C. and D.C. switches were mounted on the A.S.V. Operator's switch panel (Fig.10), and were satisfactory for operation.

4.1.10 The two Inverters Type 4B and their associated V.C.P's were mounted on the port side of the galley floor (Fig.12), and were satisfactory for maintenance.

4.1.11 Junction Box Type 340 was mounted on the port fuselage wall near the floor under the A.S.V. Operator's table (Fig.13), and was satisfactory for maintenance.

4.2 <u>Object of Trials</u>

4.2.1 To assess the performance of the equipment with the scanner mounted in a retractable radome in a new position aft of the bomb doors, and with all accepted Coastal Command modifications fitted to the equipment.

4.2.2 To determine whether any shielding exists from either the aircraft fuselage or bomb doors, when looking forward.

4.3 <u>Procedure for Trials</u>

4.3.1 To obtain the maximum ranges on various sizes of target, the aircraft was flown over the sea at heights between 500 and 2,000 ft., the size of the target being estimated on making visual contact.

4.3.2 Range checks were also made on a submarine, fully surfaced, and with conning tower only showing; photographs of the responses are shown in Figs. 19 and 20.

4.3.3 To ascertain whether any blanking existed when looking forward through the bomb doors, a number of runs were made tracking a target dead ahead, noting the accuracy of the track by visual plotting.

/4.3.4....

4.3.4 To determine whether any shielding from the aircraft fuselage was present, two runs were made on to targets with the aircraft attacking in a shallow dive, the first run at 5° and the second at 10°.

4.3.5 To assess the efficiency of the radome and scanner stabilisation, flights were made at 300 knots observing a coast line pattern all the time on the C.R.T.

4.3.6 To determine the accuracy of the heading marker using the present method of jacking up the tail for setting up, a radar bearing was taken on the Needles, Isle of Wight, and cross checked by taking a Gee fix and computing the bearing on a map.

4.4 Results

4.4.1 Range Test. With the aircraft flying over the sea at heights varying between 500 feet and 2,000 feet the following ranges on targets were obtained, and were considered satisfactory.

Target	Height of Aircraft	Range
Liner, 10,000 tons	1,000 ft.	45 N.M.
Destroyer	500 ft.	30 N.M.
Tanker 3,000 tons	1,000 ft.	35 N.M.
Aircraft Carrier	500 ft.	45 N.M.
Tug, 200 tons	500 ft.	22 N.M.
Submarine, Surfaced	500 ft.	20 N.M. Sea State 1
Submarine, Conning Tower only.	500 ft.	8 N.M. Sea State 1
Weath er Ship	2,000 ft.	(50 N.M. Intermittent (30 N.M. Continuous
Fishing Marker Buoys	500 ft.	5 N.M.
Coastlines	2,000 ft.	50 N.M.
High Ground	2,000 ft.	140 N.M. Intermittent

4.4.2 The all round cover was extremely good on both "2nd Search" and "Attack" positions of the scanner, except when banking when considerable blanking from the wings was noticed. Owing to bad cut off experienced on the "1st Search" position with the scanner tilt at -1°, it did not seem to have any useful operational application, but was useful for setting up the heading marker on the ground.

4.4.3 Flights were made tracking a ship target, with the aircraft in a shallow dive from 1,500 ft. to 500 ft, scanner tilt at - 1°, the small amount of bomb door shadow did not prevent tracking a target right to the point of attack. Interference to the picture was present due to the bomb doors but tracking accuracy was not impaired. Photographs of the C.R.T. picture were taken and are shown in Figs. 16, 17 and 18.

4.4.5 During the scanner stabilisation tests it was noticed on the first flight that after banking at about 20° the scanner was slow in recovering. After alteration to the feedback control settings in Amplifier A. 3621, subsequent flights showed the recovery time to be much improved. The pre-set feedback controls in Amplifier A. 3621 are mounted inside the pressurised unit, and for ease of servicing and adjustment, it would be much more satisfactory if they were mounted on the front panel so that adjustments can be made without first having to remove the unit from its pressure case.

4.4.6 Throughout the tests on this equipment the radome was altered in position some 120 times, and no trouble was experienced either mechanically or electrically due to cables fracturing or being chaffed at

/the.....

the flexible point of entry to the radome. At one time it was thought that the radome which was set in the "Attack" position did not retract when the undercarriage was selected "Down", but after further tests it was found that, due to the additional load on the hydraulic system, the undercarriage did not start coming down until 45 seconds after the radome had started to retract.

4.4.7 During the high speed flights, i.e. 300 knots, the vibration experienced on the scanner assembly was very slight and it was not considered necessary to make any special tests.

4.4.8 To line up the heading marker the aircraft tail was jacked up and the radome lowered to "1st Search" position. A field strength meter was then taken to a point in front of the aircraft and lined up with the bomb door centre line. The scanner was then adjusted for maximum signal on the field strength meter, and the heading marker set to the scanner heading. This method of setting up was quite satisfactory and proved quite accurate when checked by a bearing obtained on a landmark after taking a Gee fix.

4.4.9 A general aircraft assessment flight was made to Gibraltar, and the A.S.V. equipment was run continuously for 14 hours on the outward run and 8 hours on the return run, no unserviceability was experienced and the performance was considered very satisfactory by the Coastal Command Operator who took part in this flight.

4.4.10 The R.A.M. installation in the Radome to prevent reflections off the fuselage when testing on the ground, was quite satisfactory. No change in crystal current or magnetron current was noticed at any point through the full 360° rotation of the scanner. It is understood that modifications are in hand to improve the method of fixing the R.A.M. to the radome framework (Form 555 dated 9.10.52).

4.4.11 No assessment of the usefulness of the T.S.X.634 and Neon Wattmeter for overall performance measurements in the aircraft was made owing to the test set not being available.

4.4.12 After some 64 hours flying including the trip to Gibraltar, and most of this flying time being at low altitudes over the sea, including many flights in heavy rain, no damage was caused to the radome due to rain erosion.

4.4.12 Photographs were taken of the Indicator Cathode Ray Tube to illustrate effects due to bomb door shadowing, submarine response and with the scanner in its different positions. They are shown in the following order:-

Fig. 16	<u>Subject</u>:-	<u>Showing bomb door shadow</u>
	Aircraft Course	090°
	Altitude	1,000 feet.
	Range Scale	10 miles
	Tilt Setting	-1°
	Scanner Position	Attack
Fig. 17	<u>Subject</u>:-	<u>Contact within bomb door shadow</u>
	Aircraft course	270°
	Altitude	500 feet
	Range Scale	10 miles
	Range on Target	6 miles
	Target	Ship
	Tilt Setting	-1°
	Scanner Position	2nd Search

/Fig. 18....

Fig. 18	Subject:-	Bomb door shadow but contacts not hidden
	Aircraft Course	270°
	Altitude	500 feet
	Range Scale	10 miles
	Range on Target	5 and 7 miles
	Target	Ship contacts
	Tilt Setting	-1°
	Scanner Position	2nd Search
Fig. 19	Subject:-	Submarine Response
	Aircraft Course	072°
	Altitude	500 feet
	Range Scale	20 miles
	Range on Target	7 miles
	Target	Surfaced submarine
	Tilt setting	-1°
	Scanner Position	Attack
Fig. 20	Subject:-	Submarine Response
	Aircraft Course	080°
	Altitude	500 feet
	Range Scale	10 miles
	Range on Target	3 miles
	Target	Submarine Conning Tower only
	Tilt Setting	-1°
	Scanner Position	2nd Search
Fig. 21	Subject:-	General Definition I.O.W. and the Solent
	Aircraft Course	060°
	Altitude	1,500 feet
	Range Scale	10 miles
	Tilt Setting	-1°
	Scanner Position	Attack
Fig. 22	Subject:-	Max. Range over land with scanner in 1st Search
	Aircraft Course	220°
	Altitude	1,200 feet
	Range Scale	10 miles
	Tilt Setting	-1°
	Scanner Position	1st Search
Figs. 23 and 24	Subject:-	West Sector Scan with and without range rings
	Aircraft Course	250°
	Altitude	1,000 feet
	Range Scale	20 miles
	Range on target	16 miles
	Scanner Tilt	-1°
	Scanner Position	2nd Search

4.5 Remarks

4.5.1 The performance of the equipment is satisfactory and the layout of the installation acceptable subject to the bad features outlined in paras. 4.1.1 to 4.1.12 being rectified wherever possible.

5. A.R.I.5487 (Sonobuoy)

5.1 Installation Details for Stations 1, 2 and 3 (numbered fore to aft)

/5.1.1.....

5.1.1 Receiver Type 1933 and power unit Type 759 at station 1 were mounted at the forward end of the equipment rack (Fig. 15), and at station 2 mid-way along the equipment rack (Fig. 15), for station 3 they were mounted at the aft end of the equipment rack (Fig. 14), all positions being satisfactory for maintenance and operation.

5.1.2 Indicator Type 1 for station 1 was positioned at the forward end of the Navigation table (Fig. 15) and for station 2 mid-way along the Navigation table (Fig. 15), for station 3 the Indicator was positioned at the aft end of the Navigation table (Fig. 15), all being suitably positioned for operation and maintenance.

5.1.3 The Control Units Type 391 for each station were positioned immediately underneath the respective indicator units (Figs. 14 and 15), and were satisfactory for maintenance and operation.

5.1.4 The Junction Boxes Type 151 were fitted on the equipment racking immediately above each Indicator Unit (Figs. 14 and 15), all in satisfactory positions for servicing.

5.2 <u>Equipment common to all Stations</u>

5.2.1 Amplifier Unit Type X. 1150 was mounted at the aft end of the equipment racking (Fig. 15) in a satisfactory position for operation and maintenance.

5.2.2 Distribution Box Type 34 was fitted behind the port panelling at the Navigator's position.

5.2.3 The aerial was mounted 3 feet 6 inches aft of the Astra-dome and 1 foot 2 inches starboard of the aircraft centre line (Fig. 2).

5.3 <u>Object of Trials</u>

5.3.1 To determin e the polar diagram of the aerial when flying straight and level, and also under conditions of orbit with the aircraft banking up to 20°, and performance tests of the airborne equipment, using a representative directional sono-buoy for range measurements.

5.4 <u>Procedure for Trials</u>

(a) <u>Polar Diagrams</u>

5.4.1 To obtain the polar diagram of the aerial with the aircraft flying straight and level at an altitude of 1,400 feet above sea level, a clover leaf pattern was carried out over a pin-point 24 nautical miles from the ground transmitter which was situated at Cove, Nr. Farnborough, Hants. Recordings of signal strength were taken off an "S" meter fitted in the aircraft.

5.4.2 To determine the polar diagram of the aerial with the aircraft banking at 20°, one turn to port and one to starboard were carried out, using the same pin point and procedure outlined in para. 5.4.1.

(b) <u>Range Test</u>

5.4.3 To check the performance of the equipment, a representative directional buoy was dropped into the sea off Lyme Regis and the aircraft carried out a series of runs at different heights, recording carrier strength in Db's above a known reference level of 1 μv.

5.5 <u>Results</u>

5.5.1 The aerial polar diagram with the aircraft flying straight and level is shown in Fig. 25. The head and tail aspects are satisfactory; a drop of 7 Db's is apparent on both port and starboard aft aspects, this

/represents......

a drop in range from 9 to 6 miles as shown in Fig. 27.

5.5.2 The polar diagrams for the port and starboard 20° bank turns are shown superimposed in Fig. 26. The decrease in signal strength on a number of bearings on the diagram indicate that a reduction in range from 9 to 6 miles can be expected at these points.

5.5.3 The range runs were carried out with the aircraft flying at 500 and 1,000 feet above sea level, using an average performance directional buoy for providing the carrier for recording purposes; the results of these tests are shown in Fig. 27.

5.6 Remarks

5.6.1 The installation and layout is satisfactory.

5.6.2 The aerial polar diagrams on the head and tail aspects are satisfactory, a reduction in range can be expected at a number of points on the port and starboard beams as shown in Figs. 25 and 26.

6. Inter-equipment interference

6.1 Only slight interference was noticed on the A.R.I. 5487 Indicators, when the T. 1154/R.1155 and T.R. 1934/34 were transmitting, this did not affect the operational efficiency of the installation. Strong V.H.F. breakthrough was present on the audio channel of the A.R.I. 5487 over the full V.H.F. frequency range.

6.2 No interference A.S.V. 13 to A.R.I. 5487 was noticed throughout the trials.

6.3 The inter-communication system was satisfactory. No interference was experienced when all radio services were operating.

7. Conclusions

7.1 A.S.V. 13. The performance and layout of this installation is considered satisfactory and is acceptable for service use providing the bad features outlined in paras. 4.1.1 to 4.1.12 are investigated and rectified wherever possible.

7.2 A.R.I. 5487. The aerial polar diagram is not considered entirely satisfactory but may fulfil operational requirements. The layout of the installation for maintenance is considered satisfactory. Severe interference from the V.H.F. is present on the audio channel. This installation is suitable for Service use providing the above limitations are made known and accepted.

Circulation List

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TPA3/TIB1c	75 Copies
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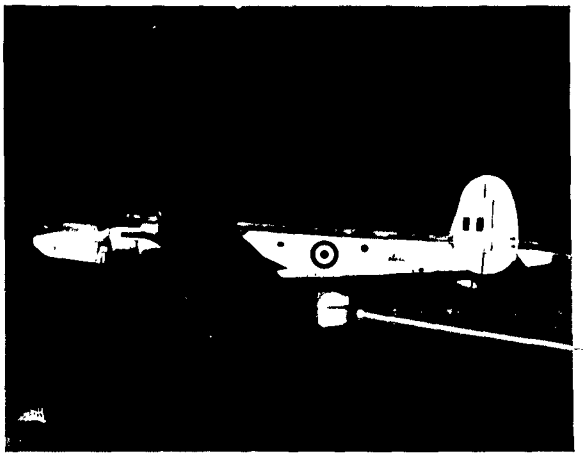


FIG.1

FIG 2

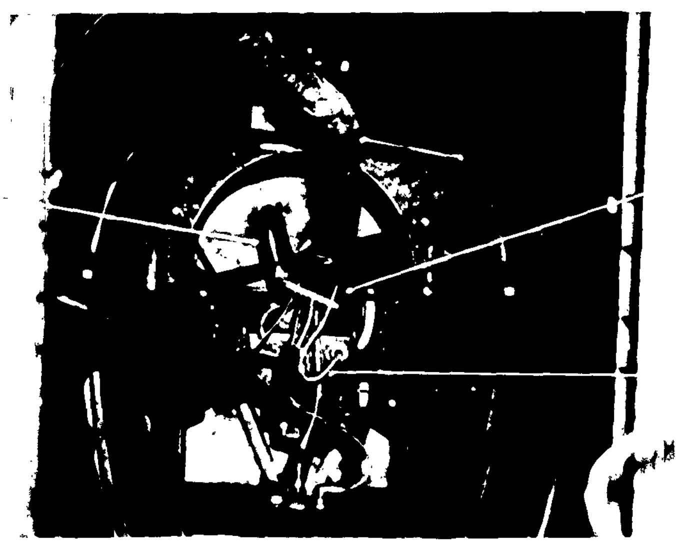
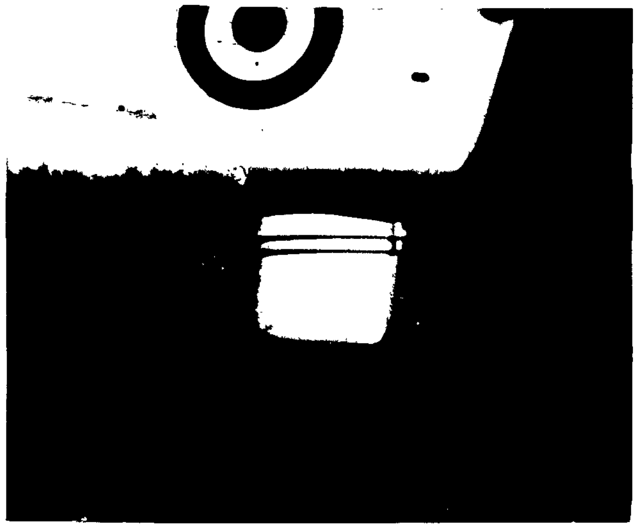


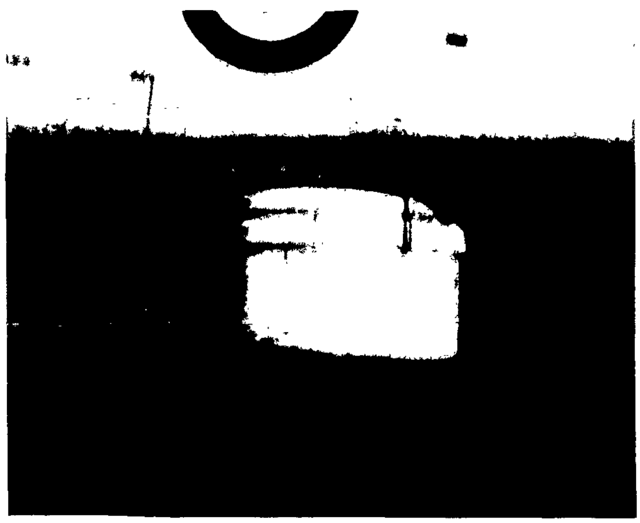
FIG 3

A.&A.E.E. NEG No.15876.



Radome in
1st Search position

FIG 4



Radome in
2nd Search position

FIG 5

Radome in
Attack position

FIG 6

A.&A.E.E. NEG No.15876.

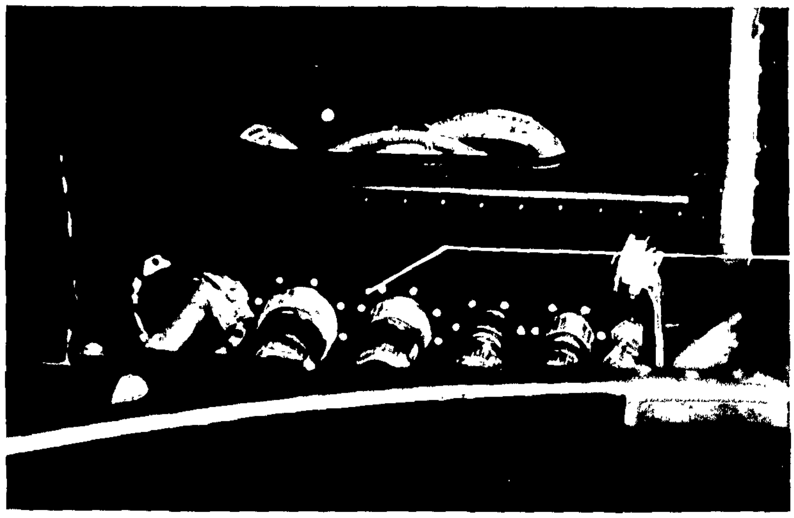


FIG. 7

FIG 8.

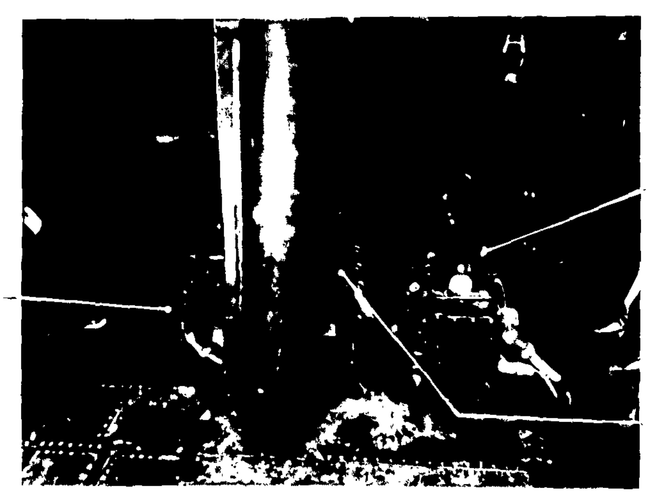


FIG 9

A.&A.E.E. NEG No.15876.

FIG 10

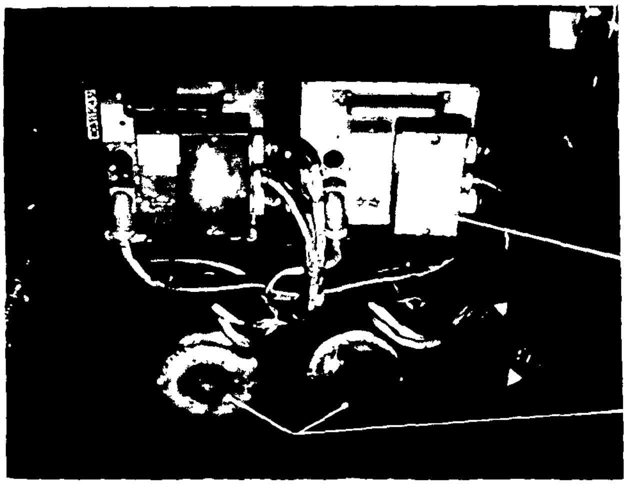


FIG 11

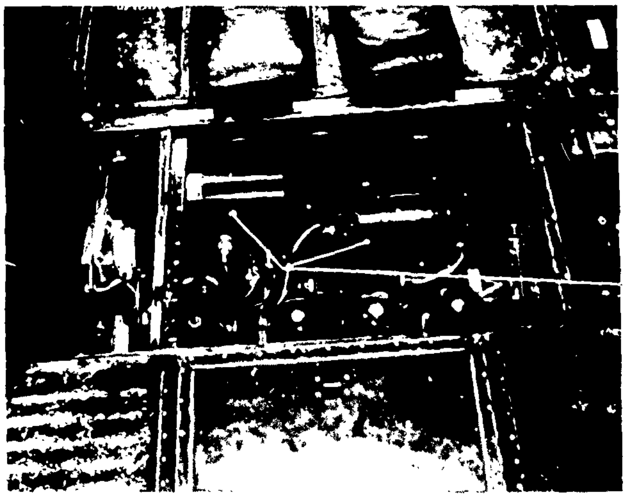


FIG 12

A.&A.E.E. NEG No.15876.

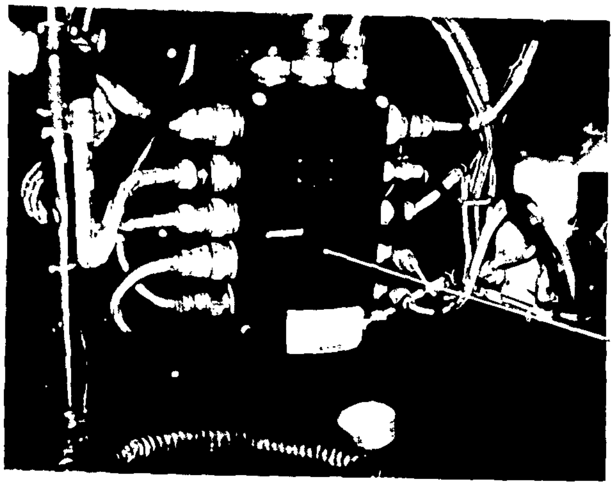


FIG. 13

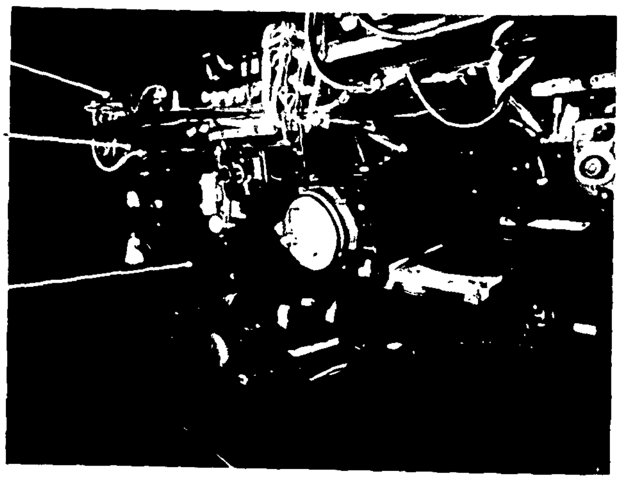


FIG. 14

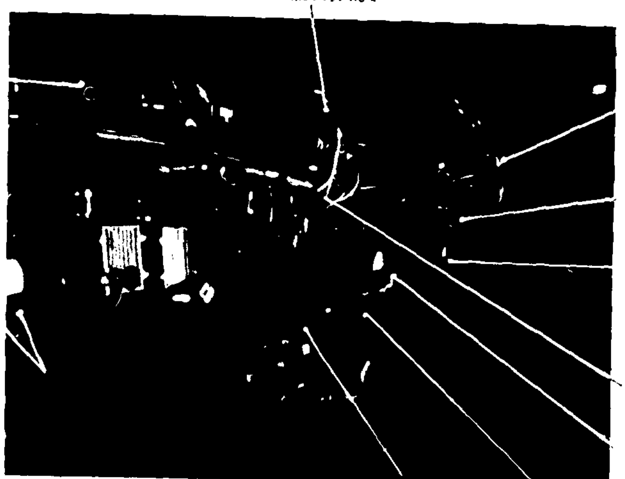


FIG.15

A.&A.E.E. NEG No.15876.

FIG 16

FIG. 17.

FIG. 18.

FIG. 19

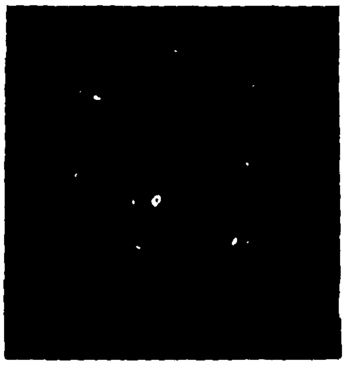


FIG 20

FIG 21

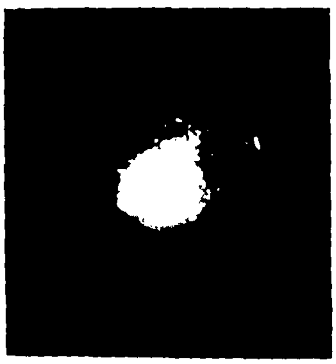


FIG 22

FIG 23

FIG 24

A.&A.E.E. NEG No. 15876

FREQUENCY ... M/c

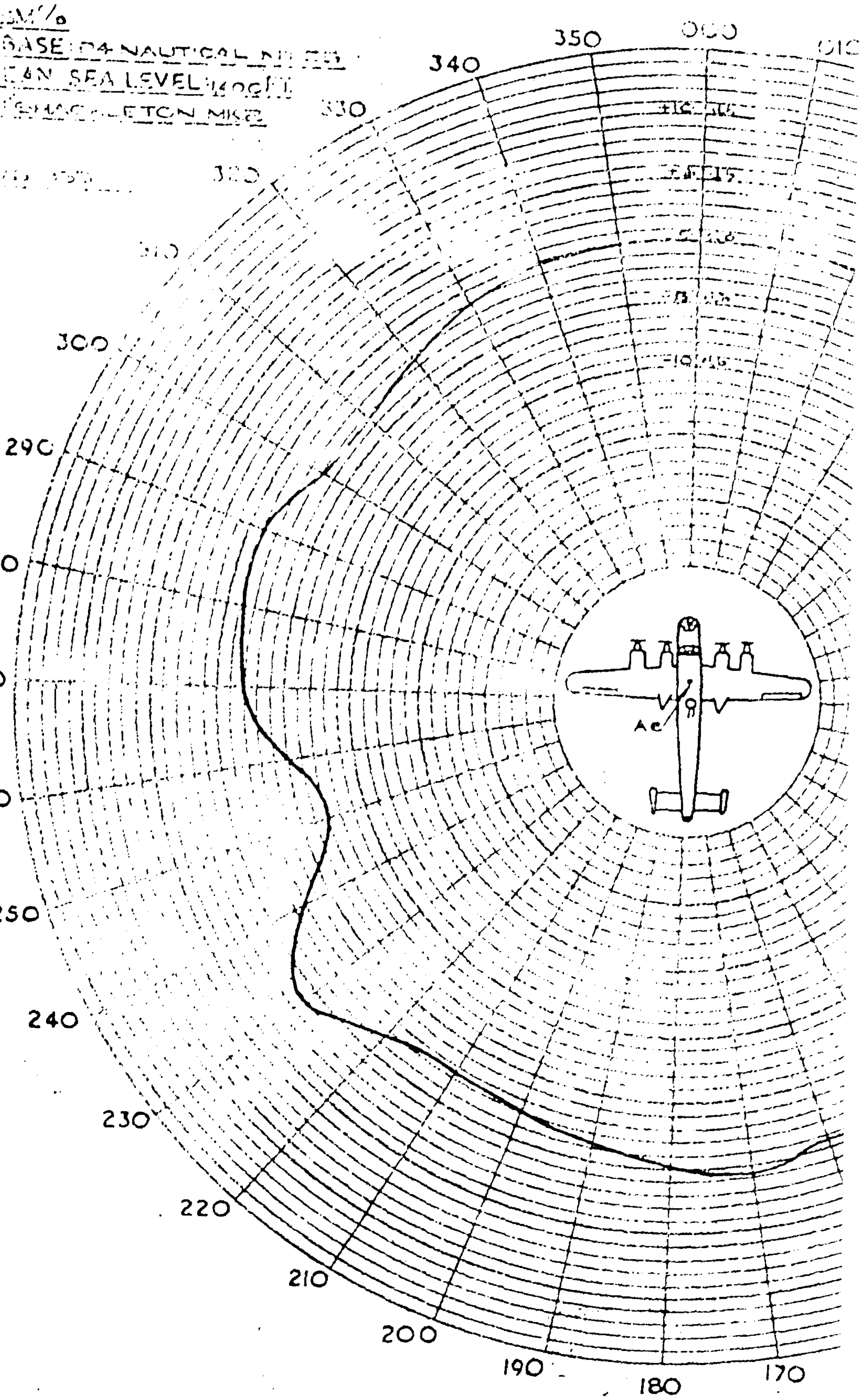
DISTANCE FROM BASE 24 NAUTICAL MILES

HEIGHT ABOVE MEAN SEA LEVEL 1400 FT

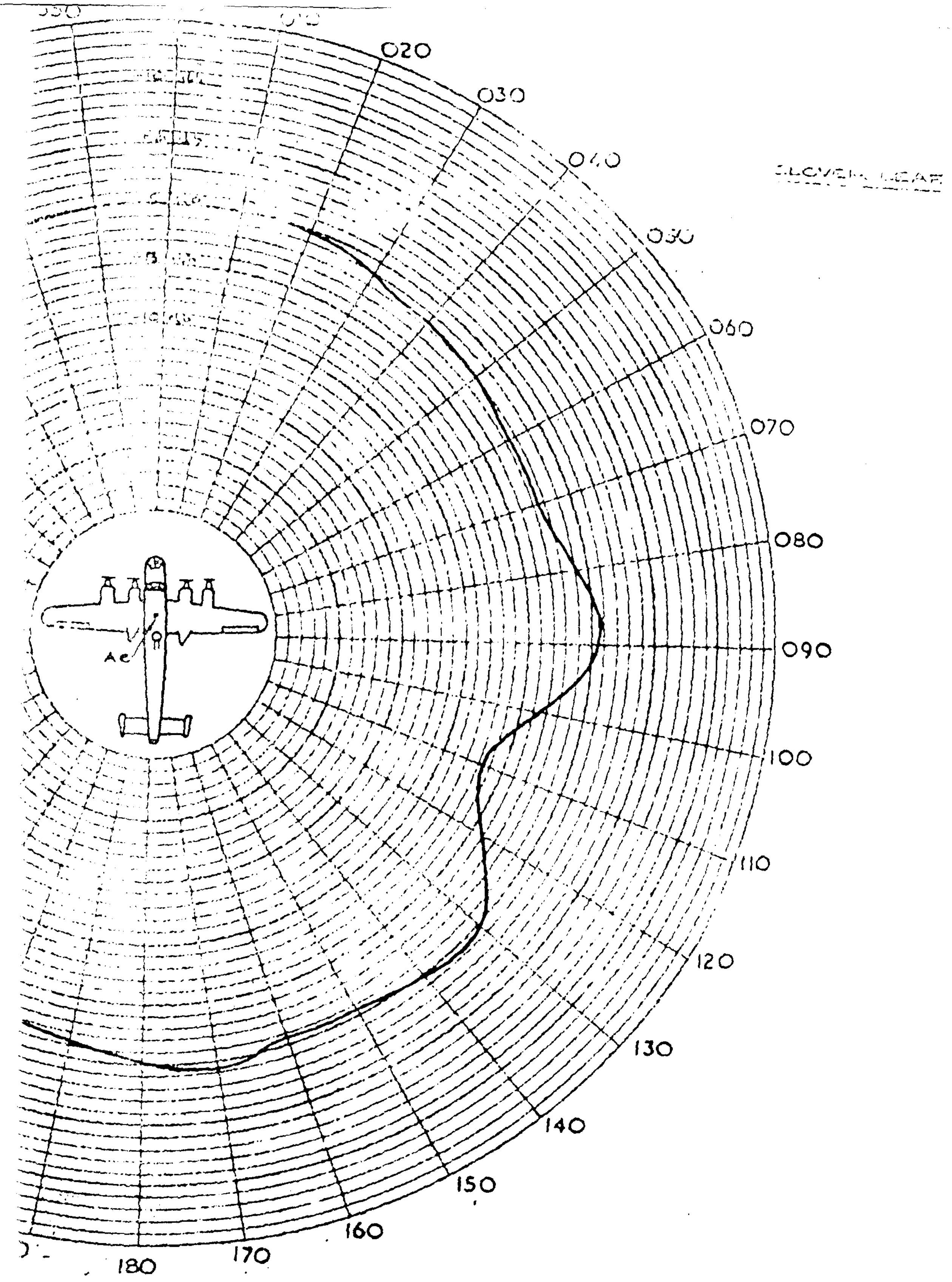
TYPE SHACKLETON MK2

AIRCRAFT ...

A.R.I. ...



SK No A4333 | 9th PART OF REPORT No A&AEE 868/1 | SHACKLETON WB833 | TR. M.L | CH. C WITHERS | APP. ... Sec 3 of P. 13



POLAR DIAGRAM
OF SONOBUOY
AERIAL SYSTEM USED ON AIRCRAFT SHACKLETON MK2

FREQUENCY: 60·55 M/s

DISTANCE FROM BASE: 24 NAUTICAL MILES

HEIGHT ABOVE MEAN SEA LEVEL: 1400 FT.

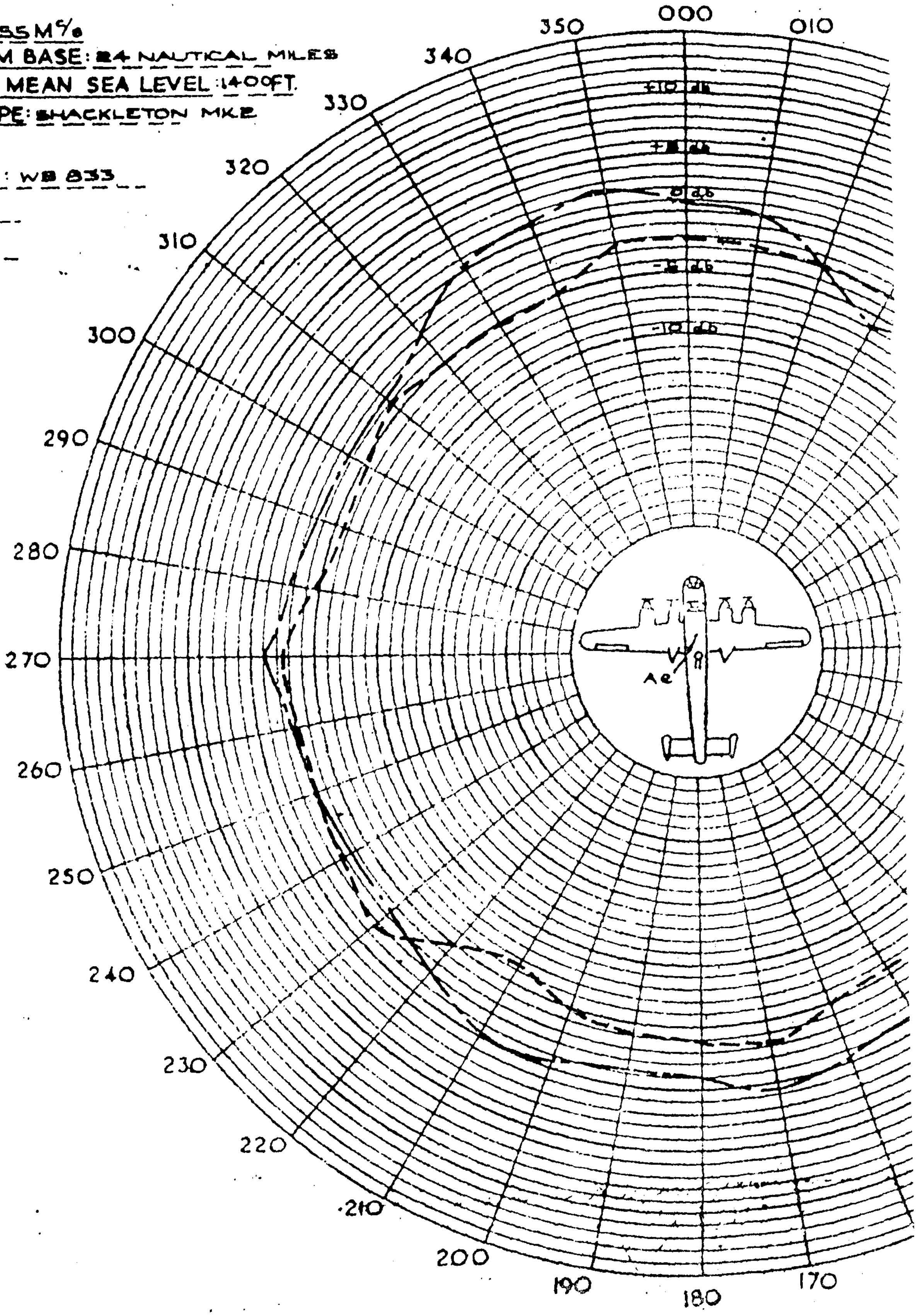
TYPE: SHACKLETON MK2

AIRCRAFT:

No: WB 833

DATE: 4-11-52

A.R.I. 5487



0 db REPRESENTING

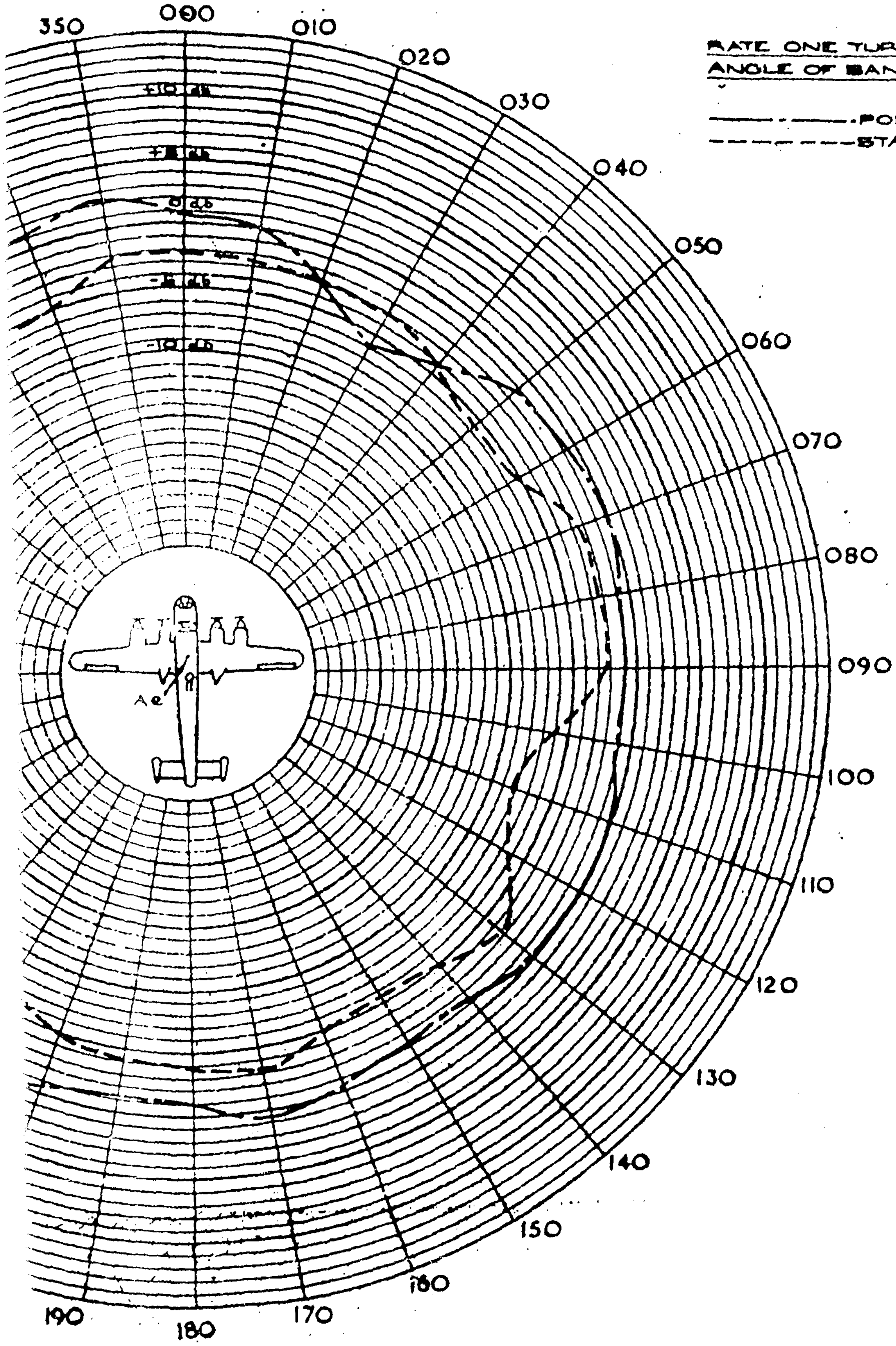
8·1 db ABOVE 1µV

SK No A4534 | 9 PART OF REPORT No A&AEE 866/1 | SHACKLETON WB 833 | TR M. | CH C. WITHERS | APP | for SofP

FIG. 26

RATE ONE TURNS.
ANGLE OF BANK 20° APPROX

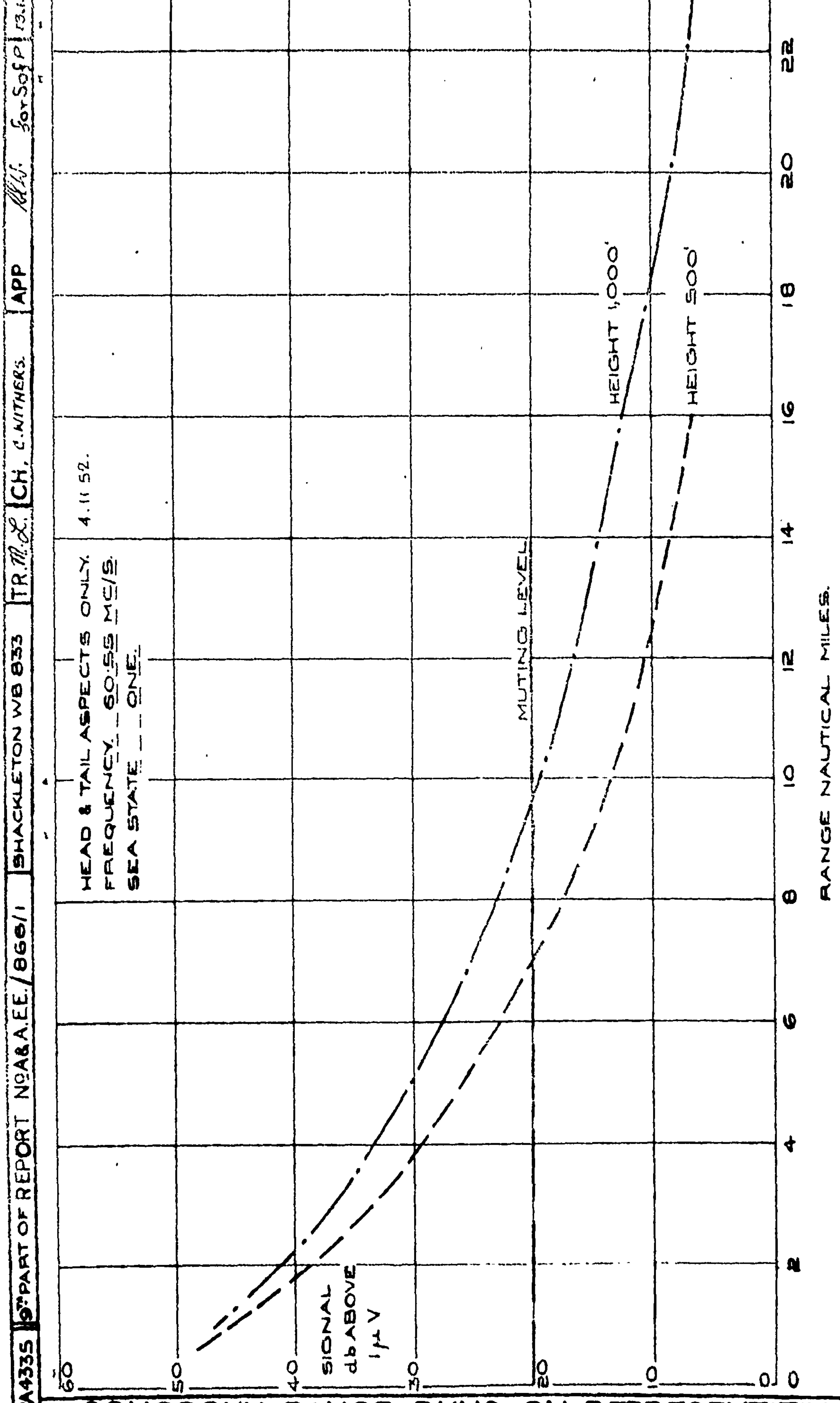
——·——·PORT TURN
– – – – – –STARBOARD TURN



POLAR DIAGRAM

AERIAL SYSTEM

FIG. 27



SONOBOUY RANGE RUNS ON REPRESENTATIVE DIRECTIONAL BOUY.

dstl

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AD#: AD 020266

Date of Search: 18 November 2008

Record Summary: AVIA 18/1478
Title: Shackleton Mk 2 aircraft: radio acceptance trials
Availability Open Document, Open Description, Normal Closure before FOI Act: 30 years
Former reference (Department) A & A E E/866/1 pt 9
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